REMARKS

Applicant has carefully reviewed and considered the Office Action mailed on May 8, 2003, and the references cited therewith. In response thereto, Applicant has amended claims 1, 6, 9, 15, 17, 24, 28, 58, 60-62, 64, and 72-75, and canceled claim 8. Claims 1-7, 9-28 and 58-77 are now pending in this application.

In The Drawings

The drawings were objected to as not showing a transistor. Applicant respectfully points out that Figure 6B shows a transistor structure. In the drawings description on pages 3-4 of the specification, it states "Figure 6B is a diagrammatic, fragmentary, cross-sectional view of one embodiment of a transistor structure in accordance with the teachings of the present invention having been fully formed." Further, on page 10, lines 17-20, it states "Annealing is accomplished by growing a sacrificial oxide layer, followed by still another wet etch. Finally, the gate oxide is grown, poly deposited and gate patterned. The result is the transistor structure 670 in Figure 6B." In the claims which recite a transistor, the language has been amended to describe a "transistor structure."

Applicant respectfully submits that the transistor structure is already shown in the Figure 6B and that the claims are supported by the drawings in accordance with 37 C.F.R. § 1.83(a). Reconsideration and removal of this objection is respectfully solicited.

§112 Rejection of the Claims

Claims 16-28 & 58-77 were rejected under 35 U.S.C. § 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which Applicant regards as the invention.

According to the Office Action, the phrase "a third layer about the process stack" in claim 16 was not clear, and the Examiner did not know what it means and did not know where it was located. Applicant respectfully traverses this rejection based on the amendments to the claims and in light of the remarks made below in support of patentability.

In answer to these questions, Applicant respectfully points out that a third layer is described as element 650 in Figure 6A in the drawings. In the present patent application

specification, by way of example and not by limitation, the third level is described on page 9, lines 22-27 where it states "With reference to Figure 6A, a third layer 650, preferably another oxide layer, perhaps a high density plasma oxide, is formed about the processing stacks to overlie them and fill trenches 618. Recalling that this invention may be practiced with or without a photoresist layer on top of second layer 616, in the event a photoresist layer is present, it would likely be removed before deposition of the third layer 650." See also a process stack 430 in Figure 4B and a process stack 530 in Figure 5, etc. Since the specification and drawings clearly describe the elements in the claims, no indefiniteness is found with the claims. Reconsideration and removal of this objection is respectfully solicited.

According to the Office Action, the phrase "a process stack extending away from the surface" in claims 17 and 24 were not clear, and the Examiner did not know how it could do this. Applicant respectfully traverses this rejection.

In answer to these questions, Applicant respectfully points out that the process stack is described in many places through the specification as a vertical stack extending upward from the surface of the substrate. By way of example and not by limitation, a process stack is described in conjunction with Figure 1:

> Through various patterning and etching processes, a plurality of trenches 118 are formed in the substrate 112 that serve to isolate three processing related stacks, or process stacks 130, from one another. As used herein, a process stack includes that portion of the substrate 112 beginning at point 132 and extending away from a surface 122 of the substrate 112 toward a point 134 at the top of the second layer 116. The surface 122, while defined as associated with the substrate, may alternatively be considered as defining a bottom of the trench 118. As is apparent from the figure, this process stack also includes first layer 114. While the figure depicts three process stacks, it should be appreciated that the present invention is not limited to any particular number. Page 5, lines 15-24.

Since the specification and drawings clearly describe the elements in the claims, no indefiniteness is found with the claims. Reconsideration and removal of this objection is respectfully solicited.

According to the Office Action, claims 28, 58, 64, 72 and 75 were not clear, and the Examiner did not how the stack could form a trench, a transistor and why there were no oxide or nitride layers left in the final structure (citing pages 6-9 and 9-10 of the Applicant's specification.

Applicant respectfully traverses this rejection based on the amendments to the claims and in light of the remarks made below in support of patentability. In the claims which recite a transistor, the language has been amended to describe a "transistor structure."

To answer the Examiner's concerns, the process stack is not used to form the trenches. The trench surrounds the process stack. The present patent application is very clear: the process stack and the trenches are both formed by patterning and etching steps. For example, Figure 2 shows the dimensions of the pull-back area which is caused by etching. In the specification of the present patent application, on page 7, lines 11-19, it states:

> In a preferred embodiment, the pull back process is any variety of wet etching. In another embodiment it is an HF etch followed by a phosphoric acid (H_3PO_4) etch from between 30 seconds to 10 minutes depending upon relative chemical strength and temperature. In one embodiment, the temperature is anywhere from room temperature to 150° C. In still another embodiment the etch is an HF etch followed by polyethylene glycol (PEG) or polypropylene glycol (PPG).
>
> It will be appreciated that the pull back processing steps of Figure 2, may occur with or without a photoresist layer deposited on top of the second layer.

Etching also defines the walls of the stack, as also shown in Figures 2 and 3, as well as the trenches.

The Examiner also was concerned that there were no oxide and nitride layers left in the final structure. This is because the stack layers of oxide and nitride are used to protect the transistor region inside the protective doped edges of the sides of the trenches. Once the isolation trenches with the doped edges are formed, the stack is no longer needed. Applicant's specification states on page 9, line 28 through page 10, line 1:

> In a preferred embodiment, a CMP step planarizes structure 610. Such step stops at an upper surface of second layer 616 whereupon the second layer 616 is removed via wet etching thereby exposing the first layer 614. Then, the first layer 614 is removed via another wet etch.

The transistor active region is placed on the substrate where the stack used to be, which is located between doped isolation areas 643 in Figure 6B. The specification states on page 10, lines 8-10:

Annealing is accomplished by growing a sacrificial oxide layer, followed by still another wet etch. Finally, the gate oxide is grown, poly deposited and gate patterned. The result is the transistor structure 670 in Figure 6B.

The final steps of gate patterning is well known to those skilled in the art and need not be shown since it is not necessary for an understanding of the subject matter sought to be patented. See 37 C.F.R. § 1.81 (a). Since we are claiming a trench isolation that can be used with a transistor, a complete transistor need not be shown to understand and practice this invention.

First §102 Rejection of the Claims

Claims 1-3, 5-7, 9, 12-15, and 28 were rejected under 35 U.S.C. § 102(b) as being anticipated by Furukawa et al. (U.S. 5,798,553). Applicant respectfully traverses this rejection based on the amendments to the claims and the remarks in support of patentability offered below.

Anticipation requires the disclosure in a single prior art reference of each element of the claim under consideration. *In re Dillon* 919 F.2d 688, 16 USPQ 2d 1897, 1908 (Fed. Cir. 1990) (*en banc*), *cert. denied*, 500 U.S. 904 (1991). It is not enough, however, that the prior art reference discloses all the claimed elements in isolation. Rather, "[a]nticipation requires the presence in a single prior reference disclosure of each and every element of the claimed invention, *arranged as in the claim*." *Lindemann Maschinenfabrik GmbH v. American Hoist & Derrick Co.*, 730 F.2d 1452, 221 USPQ 481, 485 (Fed. Cir. 1984) (*citing Connell v. Sears, Roebuck & Co.*, 722 F.2d 1542, 220 USPQ 193 (Fed. Cir. 1983)) (emphasis added).

Independent claims 1, 6, 9, 15 and 28 (and the claims which depend upon these claims) have been amended to add limitations such an implant region having a rounded corner between the portion of the substrate and the trench wall and the implant region having the same dopant type as the substrate type whereby the threshold voltage in the implant region is approximately equal to or greater than the threshold voltage on the portion of the substrate and whereby the pull back distance defines a width of the implant region which is approximately uniform around the process stack. These limitations are not found in the Furukawa et al. patent. Since all the limitations of claims 1-3, 5-7, 9, 12-15, and 28 are not found in a single reference, the rejection under 35 U.S.C. § 102(b) now fails. Reconsideration of the rejections and allowance of all claims is respectfully solicited.

Second §102 Rejection of the Claims

Claims 1, 3, 6-7, 9-10, 15, 17, 19 & 22-23 were rejected under 35 U.S.C. § 102(b) as being anticipated by Oh et al. (U.S. Statutory Invention Registration no. H204). Applicant respectfully traverses this rejection based on the amendments to the claims and the remarks in support of patentability offered below.

Independent claims 1, 6, 9, 15, and 17 (and the claims which depend upon these claims) have been amended to add limitations such an implant region having a rounded corner between the portion of the substrate and the trench wall and the implant region having the same dopant type as the substrate type whereby the threshold voltage in the implant region is approximately equal to or greater than the threshold voltage on the portion of the substrate and whereby the pull back distance defines a width of the implant region which is approximately uniform around the process stack. These limitations are not found in the Oh et al. Statutory Invention Registration. Since all the limitations of claims 1-3, 5-7, 9, 12-15, and 28 are not found in a single reference, the rejection under 35 U.S.C. § 102(b) now fails. Reconsideration of the rejections and allowance of all claims is respectfully solicited.

First §103 Rejection of the Claims

Claim 4 was rejected under 35 USC § 103(a) as being unpatentable over Furukawa et al. (U.S. 5,798,553). No second reference was provided for this obviousness rejection. Applicant respectfully traverses this rejection based on the amendments to claim 1 and the remarks in support of patentability offered below.

The Examiner has the burden under 35 U.S.C. § 103 to establish a *prima facie* case of obviousness. *In re Fine*, 837 F.2d 1071, 1074, 5 USPQ2d 1596, 1598 (Fed. Cir. 1988). To do that the Examiner must show that some objective teaching in the prior art or some knowledge generally available to one of ordinary skill in the art would lead an individual to combine the relevant teaching of the references. *Id.*

The *Fine* court stated that:

> Obviousness is tested by "what the combined teaching of the references would have suggested to those of ordinary skill in the art." *In re Keller*, 642 F.2d 413, 425, 208 USPQ 871, 878 (CCPA 1981)). But it "cannot be established by combining the teachings of the prior art to produce the claimed invention, absent

> some teaching or suggestion supporting the combination." *ACS Hosp. Sys.*, 732 F.2d at 1577, 221 USPQ at 933. And "teachings of references can be combined *only* if there is some suggestion or incentive to do so." *Id.* (emphasis in original).

The M.P.E.P. adopts this line of reasoning, stating that

> In order for the Examiner to establish a *prima facie* case of obviousness, three base criteria must be met. First, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or to combine reference teachings. Second, there must be a reasonable expectation of success. Finally, the prior art reference (or references when combined) must teach or suggest all the claim limitations. The teaching or suggestion to make the claimed combination and the reasonable expectation of success must both be found in the prior art, and not based on applicant's disclosure. *M.P.E.P.* § 2142 (citing *In re Vaeck*, 947 F.2d 488, 20 USPQ2d 1438 (Fed.Cir. 1991)).

An invention can be obvious even though the suggestion to combine prior art teachings is not found in a specific reference. *In re Oetiker*, 24 USPQ2d 1443 (Fed. Cir. 1992). At the same time, however, although it is not necessary that the cited references or prior art specifically suggest making the combination, there must be some teaching somewhere which provides the suggestion or motivation to combine prior art teachings and applies that combination to solve the same or similar problem which the claimed invention addresses. One of ordinary skill in the art will be presumed to know of any such teaching. (See, e.g., *In re Nilssen*, 851 F.2d 1401, 1403, 7 USPQ2d 1500, 1502 (Fed. Cir. 1988) and *In re Wood*, 599 F.2d 1032, 1037, 202 USPQ 171, 174 (CCPA 1979)).

The references must teach or suggest all the claim elements. M.P.E.P. § 2142 (citing *In re Vaeck*, 947 F.2d 488, 20 USPQ2d 1438 (Fed.Cir. 1991)). Applicant respectfully submits that the Office Action did not make out a *prima facie* case of obviousness because the Furukawa et al. patent fails to teach or suggest all of the elements of applicant's claimed invention. Claim 4 depends upon claim 1. As amended, claim 1 contains limitations not found in the Furukawa et al. patent. The Examiner cited a CCPA case from 1955 for the proposition that the concentration of dopants in claims 4 would have been easily found. Applicant respectfully traverses the single reference obviousness rejection under 35 U.S.C. § 103 since not all of the recited elements of the claims are found in the Furukawa et al. patent. Since all the elements of the claim are not found in the reference, Applicant assumes that the Examiner is taking Official Notice of the missing elements. Applicant respectfully objects to the taking of Official Notice with a single reference obviousness rejection and, pursuant to M.P.E.P. § 2144.03, Applicant respectfully traverses the

assertion of Official Notice and requests that the Examiner cite references in support of this position.

Since all the limitations of claim 4 are not found in the Furukawa et al. patent, the rejection under 35 U.S.C. § 103(a) now fails. Reconsideration of the rejections and allowance of all claims is respectfully solicited.

Second §103 Rejection of the Claims

Claim 8 was rejected under 35 USC § 103(a) as being unpatentable over Furukawa et al. (U.S. 5,798,553) as applied to claims 6-7 above, and further in view of Parekh et al. (U.S. 5,945,724). Claim 8 has been canceled thereby obviating this rejection.

Third §103 Rejection of the Claims

Claims 2, 4-5, 11, 13-14, and 18 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Oh et al. (U.S. Statutory Invention Registration no. H204). No second reference was cited. Applicant respectfully traverses this rejection based on the amendments to independent claims 1, 9 and 17 and the remarks in support of patentability offered below.

Applicant respectfully traverses the single reference obviousness rejection under 35 U.S.C. § 103 since not all of the recited elements of the claims are found in the Furukawa et al. patent. Since all the elements of the claim are not found in the reference, Applicant assumes that the Examiner is taking Official Notice of the missing elements. Applicant respectfully objects to the taking of Official Notice with a single reference obviousness rejection and, pursuant to M.P.E.P. § 2144.03, Applicant respectfully traverses the assertion of Official Notice and requests that the Examiner cite references in support of this position.

The Oh et al. Statutory Invention Registration discloses spacers of fillets 46 and 48 to cover tops of the implant areas (see Figure 6 of Oh et al.). Oh et al. teaches away from using an exposed implant region in column 4, lines 31 through 55 where it states:

> If TEOS fillets 46 and 48 were not present the the [*sic*] isolation trench would be as indicated by vertical lines 50 and 52 in FIG.6. Since these sidewalls are very near the "tails" of the Gaussian distributed dopant, only a very small concentration of boron would be implanted in the sidewalls. This amount of dopant has not been found to be sufficient to counteract the effects of boron segregation and the slight overetch of the silicon trench beyond the mask edge, and therefore, would not prevent inversion of the trench sidewalls. Thus, as de-

scribed above, the isolation trench is narrowed by the addition of TEOS fillets 46 and 48, which results in the sidewalls of the trench (which is yet to be formed) being located along vertical lines 54 and 56. Therefore, the use of TEOS fillets 46 and 48 to narrow window 38 results in a greater concentration of boron being implanted into the sidewalls of the isolation trench, where the amount of TEOS deposited (and thus, the subsequent size of fillets 46 and 48) will control the sidewall dopant concentration. In particular, since sidewalls 54 and 56 contain the peak doping concentration, the amount of boron implanted in sidewalls 54 and 56 by the present technique is more than sufficient to offset the effects of boron segregation and prevent inversion of the sidewalls.

Independent claims 1, 9 and 17 (and the claims which depend upon these claims) have been amended to include the limitation of an exposed implant region having a rounded corner between the portion of the substrate and the trench wall without the use of spacers covering the implant region. Thus, the present invention does not use spacers like the Oh et al. Statutory Invention Registration.

Since all the limitations of claims 2, 4-5, 11, 13-14, and 18 are not found in the Oh et al. Statutory Invention Registration., the rejection under 35 U.S.C. § 103(a) now fails. Reconsideration of the rejections and allowance of all claims is respectfully solicited.

Fourth §103 Rejection of the Claims

Claims 8 and 20-21 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Oh et al. (U.S. H204) as applied to claims 6-7 above, and further in view of Parekh et al. (U.S. 5,945,724). Claim 8 has been deleted thereby obviating this rejection. Claims 20-21 depend upon amended independent claim 17. Applicant respectfully traverses this rejection based on the amendments to independent claim 17 and the remarks in support of patentability offered below.

Independent claim 17 (and claims 20 and 21 which depend upon claim 17) has been amended to include the limitation of an exposed implant region having a rounded corner between the portion of the substrate and the trench wall without the use of spacers covering the implant region. Thus, the present invention does not use spacers like the Oh et al. Statutory Invention Registration, whether the edge is rounded or not. Further, combining a rounded corner of Parekh et al. patent with the spacers of the Oh et al. Statutory Invention Registration would not be possible since the spacers would have difficulty attaching to the rounded corner.

Since all the limitations of claims 20-21 are not found in the Oh et al. Statutory Invention Registration combined with the Parekh et al. patent, the rejection under 35 U.S.C. § 103(a) of claims 20-21 now fails. Reconsideration of the rejections and allowance of all claims is respectfully solicited.

Fifth §103 Rejection of the Claims

Claims 24-27 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Furukawa et al. (U.S. 5,798,553) in view of Oh et al. (U.S. Statutory Invention Registration no. H204). Applicant respectfully traverses this rejection based on the amendments to independent claim 24 (and claims 25-27 which depend upon claim 24) and the remarks in support of patentability offered below.

Independent claim 24 (and the claims which depend upon this claim) has been amended to add limitations such an exposed implant region having a rounded corner between the portion of the substrate and the trench wall, no use of spacers and the implant region having the same dopant type as the substrate type whereby the threshold voltage in the implant region is approximately equal to or greater than the threshold voltage on the portion of the substrate and whereby the pull back distance defines a width of the implant region which is approximately uniform around the process stack. These limitations are not found in the Furukawa et al. patent or the of Oh et al. Statutory Invention Registration. Since all the limitations of claims 24-27 are not found in the combination of references, the rejection under 35 U.S.C. § 103(a) now fails. Reconsideration of the rejections and allowance of all claims is respectfully solicited.

Sixth §103 Rejection of the Claims

Claim 27 was rejected under 35 USC § 103(a) as being unpatentable over Furukawa et al. (U.S. 5,798,553) and Oh et al. (U.S. Statutory Invention Registration no. H204) as applied to claims 24-25, and further in view of Parekh et al. (U.S. 5,945,724). Applicant respectfully traverses this rejection based on the amendments to independent claim 24 (and claim 27 which depends upon claim 24) and in light of the remarks in support of patentability offered below.

Independent claim 24 (and claim 27 which depends upon this claim) has been amended to add limitations such an exposed implant region having a rounded corner between the portion of

the substrate and the trench wall, no use of spacers and the implant region having the same dopant type as the substrate type whereby the threshold voltage in the implant region is approximately equal to or greater than the threshold voltage on the portion of the substrate and whereby the pull back distance defines a width of the implant region which is approximately uniform around the process stack. These limitations are not found in the Furukawa et al. patent or the of Oh et al. Statutory Invention Registration. Further, the Furukawa et al. patent and the of Oh et al. Statutory Invention Registration both rely on spacers to cover the implant area, whereas the present invention does not. Since all the limitations of claim 27 are not found in the combination of references, the rejection under 35 U.S.C. § 103(a) now fails. Reconsideration of the rejections and allowance of all claims is respectfully solicited.

Seventh §103 Rejection of the Claims

Claim 28 was rejected under 35 U.S.C. § 103(a) as being unpatentable over Furukawa et al. (U.S. 5,798,553) in view of Parekh et al. (U.S. 5,945,724). Applicant respectfully traverses this rejection based on the amendments to independent claim 28 and in light of the remarks in support of patentability offered below.

Independent claim 28 has been amended to add limitations such an exposed implant region having a rounded corner between the portion of the substrate and the trench wall, no use of spacers and the implant region having the same dopant type as the substrate type whereby the threshold voltage in the implant region is approximately equal to or greater than the threshold voltage on the portion of the substrate and whereby the pull back distance defines a width of the implant region which is approximately uniform around the process stack. These limitations are not found in the Furukawa et al. patent or the Parekh et al. patent. Further, combining a rounded corner of Parekh et al. patent with the spacers of the Furukawa et al. patent would not be possible since the spacers of Furukawa et al. would have difficulty attaching to the rounded corner of Parekh et al.

Since all the limitations of claim 28 are not found in the combination of references, the rejection under 35 U.S.C. § 103(a) now fails. Reconsideration of the rejections and allowance of all claims is respectfully solicited.

Eighth §103 Rejection of the Claims

Claims 58-62 & 64-76 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Furukawa et al. (U.S. 5,798,553) in view of Salling et al. (U.S. 6,515,889).). Applicant respectfully traverses this rejection based on the amendments to independent claims 58, 64, 72 and 75 (and the claims which depend upon these claims) and in light of the remarks in support of patentability offered below.

Independent claims 58, 64, 72 and 75 have been amended to add limitations such an exposed implant region having a rounded corner between the portion of the substrate and the trench wall, no use of spacers and the implant region having the same dopant type as the substrate type whereby the threshold voltage in the implant region is approximately equal to or greater than the threshold voltage on the portion of the substrate and whereby the pull back distance defines a width of the implant region which is approximately uniform around the process stack. These limitations are not found in the Furukawa et al. patent or the Salling et al. patent.

Since all the limitations of claims 58-62 and 64-76 are not found in the combination of references, the rejection under 35 U.S.C. § 103(a) now fails. Reconsideration of the rejections and allowance of all claims is respectfully solicited.

Ninth §103 Rejection of the Claims

Claims 63 and 77 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Furukawa et al. (U.S. 5,798,553) and Salling et al. (U.S. 6,515,889) as applied to claims 58-62 and 64-76 above, and further in view of Parekh et al. (U.S. 5,945,724). Applicant respectfully traverses this rejection based on the amendments to independent claims 58 and 75 (and claims 63 and 77 which depend upon claims 58 and 75) and in light of the remarks in support of patentability offered below.

Independent claims 58 and 75 have been amended to add limitations such an exposed implant region having a rounded corner between the portion of the substrate and the trench wall, no use of spacers and the implant region having the same dopant type as the substrate type whereby the threshold voltage in the implant region is approximately equal to or greater than the threshold voltage on the portion of the substrate and whereby the pull back distance defines a

width of the implant region which is approximately uniform around the process stack. These limitations are not found in the Furukawa et al. patent or the Salling et al. patent.

Since all the limitations of claims 63 and 77 are not found in the combination of references, the rejection under 35 U.S.C. § 103(a) now fails. Reconsideration of the rejections and allowance of all claims is respectfully solicited.

CONCLUSION

Applicant respectfully submits that the claims are in condition for allowance and notification to that effect is earnestly requested. The Examiner is invited to telephone Applicant's attorney at (612) 373-6904 to facilitate prosecution of this application.

If necessary, please charge any additional fees or credit overpayment to Deposit Account No. 19-0743

Respectfully submitted,

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CERTIFICATE UNDER 37 CFR 1.8: The undersigned hereby certifies that this correspondence is being deposited with the United States Postal Service with sufficient postage as first class mail, in an envelope addressed to: Commissioner of Patents, P.O.Box 1450, Alexandria, VA 22313-1450, on this 8 day of September, 2003.

Tina Kolvet
Name

Signature